

of the grazing and agricultural areas in the reserve. Three years ago the wheat crop yielded 5000 bushels. The following year it fell to 2500 bushels, and last season the yield was only 800 bushels. A cattle ranche in the range, which used to graze more than 100,000 head, will now support not more than 9000 head. As a remedy it is suggested to adopt stringent rules, regulating the number of stock and the areas on which they shall be grazed on each permit. Very little lumbering has been carried out within the reserve, which is apparently due to the difficulties and expense of transport. The timber species, coniferous and broad-leaved, number fifteen, the yellow pine being the principal timber tree. It is distributed uniformly throughout the extent of the reserve. In some ranges it forms a pure forest. Its average height is 125 feet, with 24 feet of clear trunk with a diameter of 18 inches at breast height. It varies in age from 125 to 150 years.

The Engelmann's spruce occupies the moister areas above an altitude of 9000 feet. It averages 70 feet in height and 10 inches in diameter. Its age varies from 50 to 75 years. Its growth is extremely rapid, but the tree is usually clothed with branches to the ground. A variety of the Engelmann's spruce, *Picea engelmannii*, var. *Franciscana*, known as the Arizona spruce, gives much better results, averaging 100 feet in height with 20 feet of clear trunk and a diameter of 18 inches. Red fir, white fir, western white pine, alligator juniper, and Arizona cypress also occur within the area. The deciduous trees are confined to the borders of streams and marshy areas. The reproductive capacity of the various species is exceptionally good, especially where the young growth is afforded shelter by the larger trees. The underbrush throughout the areas in which the yellow pine predominates is very small, and consequently this region has not suffered much injury from forest fires. The report also embodies detailed descriptions of the various subdivisions of the range, together with carefully prepared maps and beautiful photographic plates. Of the latter we have reproduced two as an example of the interesting way in which these papers are illustrated.

TECHNICAL EDUCATION IN LONDON.¹

THE last report of the Technical Education Board of the London County Council, dealing with the year 1903-4, directs special attention to the progress made in the provision of technical, secondary, and higher education in London during the past eleven years. Under the recent Education Act (London), 1903, the administration of the whole of the education of London passed into the hands of the new Education Committee, and the Technical Education Board ceased to exist. The present report is consequently opportune, and serves to record the great services which have been rendered to education in London by the late Board.

The most striking features of the report are the evidences provided of the increase and rapid development of polytechnic institutions, the establishment and success of London County Council schools and technical institutes, and the improvement in the equipment and staffing of secondary schools. The extent of the advances made can be estimated satisfactorily by comparing the number of educational institutions providing good scientific and technical education at the time of the supersession of the Technical Board with the number in existence in 1893, when Mr. Llewellyn Smith reported on the provision made for technical

instruction at that time. To take the case of the laboratory accommodation for the teaching of chemistry. In 1893 there appear to have been about fourteen chemical laboratories in London open in the evening for instruction; since that time well equipped departments for teaching practical chemistry have been opened in eleven new polytechnic institutions. The total volume of instruction in evening classes in chemistry in 1893 was only about 38,000 student-hours per session, and in polytechnics under 15,000 student-hours. In 1893, after omitting the attendances of students who did not attend for more than twenty hours during the session, the amount of time devoted to evening work in theoretical and practical chemistry amounted to 64,554 student-hours in the polytechnics alone.

The result obtained by comparing the advance made in the teaching of electricity and electrical technology is just as striking as in the case of chemistry. In 1893 there were five electrical laboratories open for evening instruction, while in 1903 there were twenty-three institutions giving evening instruction in electricity or electrical technology, or both. In practical electrical engineering there were only four centres in 1893 available for evening instruction, and only one applied for aid from the Board, and at this institution there were thirty-eight students. During the session 1902-3 there were, in polytechnics aided by the Board, a large and increasing number of students for electrical engineering, and the volume of instruction, omitting students who attended for less than twenty hours during the session, amounted to 43,909 student-hours. In addition to these, a large number attended classes in electricity and magnetism in the physics departments of the institutions. The volume of instruction here reached 32,872 student-hours.

Ten years ago there was scarcely any provision in London for pure technological teaching. From the list of evening classes for 1903 it appears that technological instruction is now available in a great variety of subjects, of which the most important are:—bricklaying and brick-cutting in twelve institutions, cabinet-making in nine, carpentry and joinery in twenty, furniture design in nine, masonry in nine, metal-plate work in eight, painting and decorating in twelve, photographic work in four, plastering in nine, plumbing in fifteen, printing in four, smithing in six, tailors' cutting in seven, and upholstery in six. This rapid increase in the number of polytechnics and technical institutes in which adequate provision is made for practical instruction in trade subjects has had a remarkable effect in producing an interest in the scientific principles underlying the various trades concerned. As an example, the report quotes the case of the Northampton Institute in Clerkenwell, in which district there is a very large number of special trades. In order to meet the demands of the neighbourhood, classes were started in subjects in which no organised technical instruction had previously been given in London. Some of these have been remarkably successful, and in several cases it has been found necessary to increase the number of evenings of instruction in order to provide for the large number of students in attendance.

There has been also, says the report, a natural tendency during the past few years for sporadic classes in trade subjects to disappear in consequence of the increasing popularity of the polytechnics and larger technical institutes, in which are found thoroughly well equipped laboratories and workshops. The number of distinct trades in which practical instruction is provided, and also the number of centres where such courses of instruction can be obtained, have more than doubled during the past nine years,

¹ "Annual Report of the Technical Education Board of the London County Council, 1903-1904." (Westminster: P. S. King and Son, 1904.) Price 2s. 6d.

and the number of apprentices and young workmen attending them has increased four-fold.

The great success which the rapid growth of polytechnics in different parts of London, since the formation of the Technical Education Board in 1893, has had in the development of evening instruction has not, the report points out, been achieved at the expense of other institutions; it represents a new growth, not the transference of instruction from old to new institutions. Many changes have taken place in the older polytechnics to bring them more into touch with modern requirements, and this has been accompanied in nearly every case by an increase in the volume of instruction. Statistics have been compiled, with regard to the attendances which have been made, from 1893 for a period extending over eight years. It has been impossible to give particulars with regard to all the 4000 classes in the numerous subjects of instruction aided by the London County Council, but mechanical engineering, electrical engineering, carpentry and joinery, plumbing, other building trade classes, experimental physics, chemistry, and mathematics have been selected. The total volume of instruction in these subjects, taken together, shows an increase from 118,732 student-hours in 1893 to 454,363 student-hours for 1900-1. Since then the number of artisan students has been increasing steadily. The increase in the amount of work done by the students, speaking generally, appears to have been even greater than the growth in numbers. A growing proportion of the students are now, it is satisfactory to find, taking advantage of the systematic courses which have been arranged, involving attendance on several evenings a week; and it is not surprising to find the Board recording its belief that the educational value of the work done in polytechnics, especially as regards the young mechanic, has been in this way greatly increased.

As has been frequently pointed out, it was from the first the policy of the Board to avail itself of the opportunity of aiding the supply of technical instruction rather than of creating a direct supply, wherever public institutions have existed capable of responding to the Board's aid by such developments of efficient technical instruction as might be expected to meet the requirements of the district. It has been necessary, however, to provide two classes of institution, for the conduct of which the London County Council is wholly responsible, viz. :—

(a) Institutions which provide instruction of such a highly specialised character that it is necessary for them to draw their students from the whole of London; for it has been impossible for any institution with the ordinary sources of income to provide the equipment and the highly specialised teachers necessary.

(b) Local institutions, providing instruction of a more ordinary character in districts in which no public institutions under a responsible governing body existed which could be utilised for the Council's requirements.

There are many other subjects of interest included in the report, and some of them have already been dealt with from time to time in these columns. It must suffice here, by way of conclusion, to mention briefly the work the Board has accomplished in aiding and extending satisfactory instruction in science in the public secondary schools of London. Seventeen chemical laboratories have been equipped in new buildings, generally in wings added to existing school premises, and three rooms used for class purposes have been converted into chemical laboratories. Four large rooms have been fitted up for practical work in physics and chemistry. Sixteen physical laboratories have been equipped in new buildings, and ten large class-

rooms have been adapted for practical work in physics, in addition to the four mentioned above, in which practical work in chemistry is also carried on. Thus fifty laboratories have been equipped in secondary schools for boys, with bench accommodation for more than 1200 pupils working simultaneously, or for 6000 pupils working one day a week. Twenty-five science lecture-rooms have been provided, sixteen of these being specially constructed for the purpose in new buildings. A large number of additional science masters have been appointed as a result of the Board's maintenance grants. In secondary schools for girls, laboratories have in some cases been provided for practical work in physics, chemistry, and botany, and some of those in existence have been equipped suitably to meet modern requirements.

A. T. S.

NOTES.

THE list of appointments on the occasion of His Majesty's birthday includes the following honours conferred upon men of science :—Mr. W. H. M. Christie, C.B., F.R.S., has been promoted to the rank of Knight Commander of the Order of the Bath (K.C.B. Civil Division). Dr. J. W. Swan, F.R.S., has received the honour of Knighthood. The Hon. C. A. Parsons, F.R.S., has been appointed a Companion of the Order of the Bath (C.B.). Mr. Francis Watts, Director of Agriculture in the Island of Antigua, and analytical and agricultural chemist for the colony of the Leeward Islands, has been made a Companion of the Order of Saint Michael and Saint George (C.M.G.).

THE council of the Royal Society has made the following award of medals for this year :—The Copley medal to Sir William Crookes, F.R.S., for his long-continued researches in spectroscopic chemistry, on electrical and mechanical phenomena in highly rarefied gases, on radio-active phenomena, and other subjects. The Rumford medal to Prof. Ernest Rutherford, F.R.S., for his researches on radio-activity, particularly for his discovery of the existence and properties of the gaseous emanations from radio-active bodies. A Royal medal to Colonel David Bruce, R.A.M.C., F.R.S., for his researches in the pathology of Malta fever, nagana, and sleeping sickness, and especially for his discoveries as regards the exact causes of these diseases. A Royal medal to Prof. William Burnside, F.R.S., for his researches in mathematics, particularly in the theory of groups. The Davy medal to Prof. William Henry Perkin, jun., F.R.S., for his discoveries in organic chemistry. The Darwin medal to Mr. William Bateson, F.R.S., for his contribution to the theory of organic evolution by his researches on variation and heredity. The Sylvester medal to Prof. Georg Cantor for his researches in the theories of aggregates and of sets of points of the arithmetic continuum, of transfinite numbers, and Fourier's series. The Hughes medal to Dr. Joseph Wilson Swan for his invention of the electric incandescent lamp and various improvements in practical applications of electricity.

THE following is a list of fellows who have been recommended by the president and council of the Royal Society for election into the council for the year 1905, at the anniversary meeting to be held on November 30 :—president, Sir William Huggins, K.C.B., O.M.; treasurer, Mr. A. B. Kempe; secretaries, Prof. J. Larmor, Sir Archibald Geikie; foreign secretary, Mr. F. Darwin. Other members of the council :—Dr. Shelford Bidwell, Mr. G. A. Boulenger, Colonel D. Bruce, R.A.M.C., Mr. F. W. Dyson, Prof. Percy F. Frankland, Prof. F. Gotch, Dr. E. W. Hobson, Prof.